



# Ø BEAT



COLO. SPRINGS,  
COLORADO

SEPTEMBER 1980

## Let the Sun Shine In!!!

### UPDATE ON SOLAR CELL TECHNOLOGY

#### The State of the Art and Where It's Heading

Most of us hams are generally familiar with the application of solar cells in amateur radio. That isn't a difficult feat in the present stage of solar cell development because over 90 per cent of the applications are in two areas: solar battery chargers and solar powered QRP transmitters and receivers. Although Photovoltaic technology has been around for some time, we hams, whom everybody knows are known for our ingenuity and resourcefulness, have done little experimentation to explore the unlimited potential of solar cell applications. How could we have overlooked this virgin territory? The answer is simple. The cost of solar cells is just too darned high. Purchasing enough cells for experiments in constructing even a low powered array would blow the daylights out of any ham's budget. A typical solar cell purchased at a Radio Shack will cost in the neighborhood of seven to ten dollars depending on output capacity. The typical solar cell is capable of delivering about 1/2 watt of peak power (placed in direct, bright sunlight).

Since standard solar cells are almost pure silicon one might wonder why they are so expensive. After all, silicon is the most plentiful mineral on earth and is as close as the nearest sand box. The problem is that although Photovoltaic theory is not new, mass production techniques for solar cells sure are. Present processes for making solar cells are laborious and wasteful.

Silicon for solar cells must be pure within 1 part in 1 billion. Although it is not easy to refine it that pure, the biggest manufacturing problem results from the fact that a solar cell must be made from a single silicon crystal. Today, solar cells are made by sawing wafers from large single crystals of high purity silicon grown in furnaces (taking weeks at very high temperatures to grow). These large crystals are from 2 to 3 inches in diameter and are about 2 feet long. The wasteful part of the operation comes from the fact that the wafers

being cut are about the same thickness as the saw blade. In other words, 50% of the crystal is lost when sawing the silicon wafers! To make matters worse, because the sawing operation leaves the surfaces far rougher than they should be, the wafers must then be laboriously polished. Consequently, despite the low initial cost of silicon, today's solar cell arrays are expensive — about \$15–20 per peak watt of generating capacity.

To be within the price range of the average radio amateur the cost is going to have to be a lot lower than that. Fortunately, big brother, the Department of Energy, agrees with us. Their goal is to reduce the cost of solar cells to \$.50 per peak watt by 1986. That means our Radio Shack price should be about \$.25 per cell! That will put the experience of building "primary source" solar arrays within the reach of many, many ham experimenters.

It's one thing to make a goal and quite another to attain it. In this case, however, the odds look pretty good. One of the brightest stars on the horizon is standing over the Westinghouse Corporation. They are developing a new process in which single crystal silicon is produced automatically in the form of a continuous ribbon or web of material.

Westinghouse calls its new material "silicon dendritic web". To start the process, a seed is lowered into the melt and a thick button of single crystal silicon forms in the supercooled surface region of the melt. When the button is rapidly withdrawn, dendrites (or icicles) form at its two ends. A film of silicon is carried up between the two dendrites, which act as a frame, in the same way as when a child dips a wire loop into a soap solution.

The film, which is supported by surface tension between the dendrites, solidifies rapidly — much more rapidly than in the convectional horizontally grown method. The operation can be prolonged indefinitely by simply replenishing the silicon in the melt. The faces of the web are natural crystal faces so the ribbon grows with mirror-smooth surfaces that are essentially ready for solar cell fabrication except for trimming off the edges using laser beams. The thickness of the web is only 5-6 mils.

*Continued on Page 3*

## P.P.R.A.A. DIRECTORS

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(\* Two-year board terms began November 1979)

**ZERO BEAT** is published monthly in the interest of the members of the Pikes Peak Radio Amateur Association, Colorado Springs, CO. Permission is given to reprint articles or excerpts provided credit is given. Deadline for submission of articles to be published is the third week of the month. Classified accepted anytime.

The Pikes Peak Radio Amateur Association meets on the second Wednesday of every month at Sabin Jr. High School, 3605 N. Carefree Circle at 7:30 p.m. and all amateurs and interested persons are cordially invited.

Editor: Jim Colvin NØAVY, 4610 Topaz, Colorado Springs, Colorado, 80918 598-7704

### AUGUST MEETING MINUTES

The August meeting of the Pikes Peak Radio Amateur Club was called to order at 7:34 P.M. August 13, 1980 at Sabin Jr. High School by Don Lohse KBØKQ. Members and guests introduced themselves.

An excellent program on "RF Radiation" was given by Don Fraser WA9WWS.

The July minutes were approved as written.

NØDV, Dave Vierling, announced that the Enduro will be Sept. 21, all day. People are needed for communications, and as checkpoint workers. 52 Simplex will be used. Dave would prefer workers use antennas other than rubber ducks. The club picnic will be Sunday, August 24 at KØROL, Oak's cabin.

The CCARC (Colorado Council of Amateur Radio Clubs) meeting was attended by Chuck WØRNT, and Oak KØROL on July 26th in Rifle, Colo. Chuck reported that a new Colorado Callbook will be out the end of August. The cost will be \$3.00. These may be purchased by the club at \$2.00 for resale at \$3.00. A motion was made and approved that the club purchase 150 callbooks for resale. There will be a CCARC meeting in Colorado Springs on October 25.

The October meeting of the PPRAC will be an election meeting. Please consider your suggestions for nominations. The Board meeting will be Oct. 8 at which time the board will function as a nominating committee, submitting one name for each office. Further nominations will be taken from the floor at the October meeting.

Smitty WBØLTV announced that Amateur Radio signs are available from 73 Magazine for local clubs.

AAØL Ray announced that the Central States VHF Convention will be this coming weekend from 9 A.M. Friday morning until Sunday Noon at the Holiday Inn North.

Don KBØKQ has received thank you notes for our communications work from Springsree, the Regatta in Monument, the main office of Springsree, and the Walk for Mankind.

Two or three more people are needed for the Public Service Committee for coordination of public service activities.

Don KBØKQ reminded everyone of the Breakfast every Saturday morning at Kings Country Kitchen.


WBØLTV Smitty brought up the importance of DFing practice. These skills have been needed in recent months.

Bud WBØTIB announced again that for reporting WX the WX Service is interested in reports of hail — marble size or larger, and/or more than one inch of rain in an hour.

NØDV Dave conducted the monthly raffle. Don reminded everyone that the deadline for Ø Beat is Aug. 26th.

The meeting was adjourned at 10 P.M.

Respectfully submitted,  
Lorna WDØBTF



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## PPFMA

The new 16/76 machine is operational. There are some refinements yet to be accomplished, however accessibility at the present location makes modification and maintenance of the equipment much less an expensive chore. The coverage from this location is not as wide-spread as the coverage from Cheyenne Mountain but it is very good locally and interference between this machine and the Boulder machine is eliminated. Speaking of eliminated—the transmitter delay has been reduced, resulting in no audible "tail". Easy to get accustomed to but it must be awfully frustrating to habitual kerchunkers.

For the past month the 37/97 repeater has been exceptionally busy with tourist directions which in my opinion is as essential a public service activity as some of the others we get involved in; particularly since we are providing assistance to fellow amateurs. Things get a little "out of hand" though when a ham from back east show is not familiar with the area and repeater coverage calls in from I-70 east of get directions through Denver or to wherever and someone accommodates him with extensive directions. The application of a voice "program" to provide those non-members, and tourists with a description of the machine, its primary function and some guidance in its use has been suggested and is being considered. In the interim, it's up to us to keep the uninformed in line and QSY to a local repeater whenever possible for the lengthy and involved QSO.

We have also had a busy month with emergency services and scheduled public service events. Here's what we did:

7-27-80: W8ARO reported a car turned over on I-70 east of the CSP via 37/97 and NØBZ.

7-27-80: WØWNX reported a forest fire 6-8 miles south of 11 Mile Reservoir to the U.S. Forest Service via 37/97 and NØBZ.

8-2-80: KØKUO handled a request for assistance for a disabled motorist by W5MBX on 37/97.

8-9-80: WØDYU prevented a suicide after discovering a suspiciously parked car off I-25 between Colorado Springs and Pueblo. Don pulled the victim from the car and radioed for help on 37/97. KØKZI called the CSP.

8-9-80: The 37/97 machine was used by EPCS&R hams in the successful two day search for a missing person on Pikes Peak.

8-10-80: Thanks to the many hams who helped make the Pikes Peak Marathon a success again this year by providing essential communications for the officials and EPCS&R medical teams. The 37/97 repeater was used extensively.

8-14-80: SERVCOM was activated by the National Weather Service to monitor extreme flooding conditions in the Colorado Springs area. NØATE and WØQDCD officiated as 37/97 net control at the National Weather Service office. The new station operated beautifully.

8-13-80: KØYUO patched WØQVYV to the CSP via 37/97 to report an accident on I-70 east of Limon, CO.

8-24-80: KØQHW assisted a disabled motorist near the A.F. Academy on I-25 in getting help via 37/97.

8-21 thru 24, 80: the PPFMA and many local hams provided communications in coordinating the Vetter motorcycle rally held at the Flying W Ranch. All tours and events were accompanied by ham operators. The hams were provided with red shirts marked with a large white cross and the words "Emergency Radio" and "Amateur Operator" making the communicators highly visible. These shirts now belong to the PPFMA and are available for loan to public service groups requiring "highly visible" hams. See NØBZ if you need them.

73  
WØMBZ

If it's CW, it's communications.

832-  
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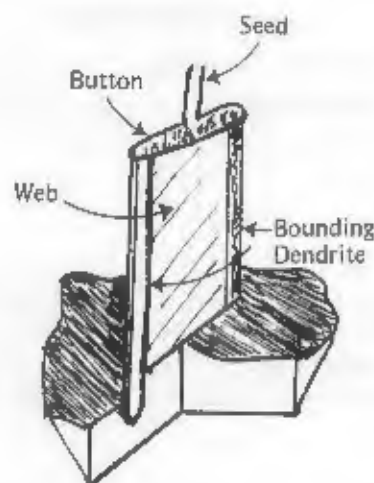
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## SOLAR TECHNOLOGY *Continued from page 1*

Westinghouse forecasts they will be producing the equivalent of two cells per minute per furnace by the end of 1980, and say that cell cost may be as low as \$1 per peak watt by the end of 1981 (for those of us who are market speculators, Westinghouse does have the method patented).

In summary, solar cell technology is just starting to move forward by leaps and bounds and is waiting for the experimenter to help it grow up. How many applications are there for solar cells in addition to the two areas we hams all know and love? Benjamin Franklin may have described it best while witnessing the launching of the world's first hot air balloon when someone laughed and asked "Of what possible good could it be?" Ben replied "Of what good is a new born baby?"

Al Bailey, ADØZ

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## SHOCK HAZARD CONSIDERATIONS

*How much current does it take to kill you?*

That's a difficult question to answer since it depends on several different factors.

While shock hazard limitations are normally presented as voltage levels, it should be understood that it is ultimately current, and not voltage that constitutes the real hazard. The three factors that determine the severity of electrical shock are:

1. Quantity of current through the body
2. Duration of time that current flows through the body
3. Current path through the body

The voltage necessary to produce the fatal current is dependent upon the resistance of the body, contact conditions, and the path through the body. The limit of extra low voltage considered to be a safe upper limit under normal conditions is approximately 30-40 volts. The following tables of body resistance and current reactions are subject to many variables and therefore are only approximations.

TABLE 1. Human Body Resistance to Electrical Current

CONDITION	BODY RESISTANCE
Dry Skin	100,000 to 600,000 ohms
Wet Skin	1,000 ohms
Internal Body (Hand to Foot)	400 to 600 ohms
Ear to Ear	(about) 100 ohms

TABLE 2. Probable Effects of Shock

CURRENT VALUES (mA)	EFFECTS
1 mA	Estimated perception.
104 mA	Surprise, sensation of shock. Not painful, individual can still let go.
4-15 mA	Painful shock, reflex action. Individual can usually still let go at this point.
15-20 mA	Painful shock. Muscular control is lost in current path. Cannot let go.
20-50 mA	Painful muscular contraction, breathing difficult.
50-100 mA (Possible)	Ventricular Fibrillation.
100-200 mA (Certain)	Heart stoppage, instant death. No known remedy unless defibrillation equipment and operator are available.
200 mA-Up	Severe burns. Severe muscular contraction. Chest muscles clamp and stop the heart for the duration of the shock.

### NOTE 1

In addition to the above, relatively small currents can be lethal if the path includes a vital part of the body such as the heart or lungs.

### NOTE 2

There are two types of burns caused by electricity. Those produced by heat of the arc which occurs when the body touches a high-voltage source, and those caused by passage of electrical current through the skin and tissue. Once the skin and tissue have been broken down, and if the voltage source is not current-limited, the current can be expected to rise rapidly to possible lethal levels.

Remember, the old adage of "Keep one hand in your pocket when making voltage/current checks" is still good advice.

*From Hewlett-Packard Bench Briefs*



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## AUGUST BOARD MINUTES

The board met August 4 at Don and Joyce Lohse's, 1410 E. LaSalle at 7:30 P.M. Those present were Don, KBØKQ; Dave, NØDV; Ray, AAØL; Lorna, WDØBTF; Dick, WBØPNX; Joyce, KAØGJN; Oak, KØROL; and Charleen, WBØYOB.

The board unanimously voted to transfer the SERVCOM funds to Bud WBØTIB to defray expenses of purchase of a radio for weather service use. The board also voted to buy a set of signs from 73 Magazine and Smitty WBØLTV will donate a set so that the club will have two sets of amateur radio signs.

Lorna, WDØBTF, will take care of the August program for the meeting August 13.

VHF Contest will be held at Ray's, AAØL, on Sept. 13, 14, & 15. Ray will make an announcement at the September 10 meeting.

The annual club picnic will be August 23 & 24 at Oak's, KØROL, cabin. Bring your own food as the club will furnish beer and pop.

Elections are coming soon. The board will serve as the nominating committee so please submit suggestions to them. We will elect four officers and four board members.

PR committee chairman will be Warren WBØSJR and Bob NØDJ.

Oak, KØROL, gave a report from the CCARC meeting in Glenwood Springs. Colorado Springs will be host October 24 to the CCARC and Oak will need our help.

Other matters discussed were antennas for Field Day, Christmas Party location, new meeting place, and club station location.

The next board meeting will be held on September 8, 1980 at 7:30 P.M. at Dave Vierling's, NØDV, 2511 N. Tejon.

Respectfully submitted,  
Charleen WBØYOB

## de the President

At the last meeting I encouraged members to consider people for nomination as club officers and directors. I hope that many of you are doing that now. We as a club must make sure that we take advantage of the best resource we have — our members. It may seem like a great bother to get involved in the business of helping to chart the direction of the club, but it really isn't. What it takes is a genuine concern for what we can do as a well-organized group of amateurs. So many of you at one time or another have said to yourself, "why did they do it that way, why not this way?" It's because that was the consensus of those people involved in making the decision. Any member has the right to speak up and get involved in any of the board or club meetings. Their opinions and ideas are just as important as anyone's.

To be an officer or director actually requires very little time. One extra meeting a month, and an occasional phone call. But the opportunity to contribute is enormous. If you think you would be interested, or know someone who is, please let us know. I have some people who have the desire, intelligence and concern necessary in mind myself. So get a hold of us, or speak up at the meeting. I would also like to encourage every single member to attend the October meeting. At least care enough to come and cast your vote. We all know the old saying "If you don't care enough to vote, you've got no room to complain." We can do so much if we all get our act together. Hope to see you all there.

73's  
Don KBØKQ

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### MEETING NOTICE

The September meeting of the Pikes Peak Radio Amateur Association will be held on September 10 at 7:30 p.m. at Sabin Jr. High. The program will be Over the Horizon Backscatter Radar (i.e. the woodpecker). All members and their guests and any other interested person are invited to attend.

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